**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, DC 20554**

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| In the Matter of | ) | |
| | ) | |
| Expanding Flexible Use of the 3.7 to 4.2 GHz Band | ) | GN Docket No. 18–122 |
| | ) | |
| Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz | ) | GN Docket No. 17-183 (Inquiry Terminated as to 3.7-4.2 GHz) |
| | ) | |
| Petition for Rulemaking to Amend and Modernize Parts 25 and 101 of the Commission's Rules to Authorize and Facilitate the Deployment of Licensed Point-to-Multipoint Fixed Wireless Broadband Service in the 3.7-4.2 GHz Band | ) | RM-11791 |
| | ) | |
| Fixed Wireless Communications Coalition, Inc., Request for Modified Coordination Procedures in Band Shared Between the Fixed Service and the Fixed Satellite Service | ) | RM-11778 |

**To: The Commission**

## COMMENTS OF GARMIN INTERNATIONAL, INC.


Clayton Barber
Principal Engineer
.
Garmin International, Inc.
1200 E. 151st Street
Olathe, Kansas 66062
(913) 440-1375 Direct
913-596-8495 Mobile
clay.barber@garmin.com

David Kight
Asst. General Counsel
Employment and Regulatory Affairs
Garmin International, Inc.
1200 E. 151st Street
Olathe, Kansas 66062
(913) 440-6151 Direct
(913) 397-9079 Fax
david.kight@garmin.com

Helen E. Disenhaus
Telecommunications Law Professionals PLLC
1025 Connecticut Avenue, NW Suite 1011
Washington, DC 20036
Phone: 202-789-3123
Fax: 202-789-3122
hdisenhaus@telecomlawpros.com
Its Attorneys


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## EXECUTIVE SUMMARY

Garmin International, Inc. ("Garmin") is a leading provider of radio altimeters that provide critical information about an aircraft's height above ground to pilots and aircraft safety systems. A radio altimeter, which is a relatively low power device, may fully utilize the 200 MHz of spectrum in the 4.2-4.4 GHz band as the device sends signals to the ground and computes the aircraft's height above ground based on the elapsed time for receipt of reflected signals. Despite its general support for broadband deployment, Garmin is concerned that more intensive use of the adjacent 3.7-4.2 GHz band without appropriate emissions limits may lead to harmful interference to radio altimeters, which are used as an input to key aircraft safety systems.

The Commission should defer adoption of any rules for the 3.7-4.2 GHz band pending completion of on-going industry testing that will inform the needed definition of out-of-band emissions limits for emissions into the 4.2-4.4 GHz band. The Commission should also provide additional data with respect to contemplated parameters of equipment that would be permitted to operate in the 3.7-4.2 GHz band under the new rules, so that testing can take this into account, including for analysis of aggregate interference. Garmin's preliminary analysis indicates that radio altimeters may experience harmful interference from new emissions in the 3.7-4.2 GHz band; thus, it is imperative that the Commission develop appropriate emissions limits to protect radio altimeters. Garmin also urges the Commission to fully coordinate with the Federal Aviation Administration regarding any rules that could affect radio altimeter operation in the 4.2-4.4 GHz band.

The aviation safety systems that rely on receipt of essential radio altimeter data are critical to public safety; thus, the Commission must ensure that radio altimeter operation continues unimpaired if the Commission permits more intensive use of the 3.7-4.2 MHz band.

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**To: The Commission**

## COMMENTS OF GARMIN INTERNATIONAL, INC.

Garmin International, Inc. ("Garmin") files these comments in response to the solicitation of comments by the Federal Communications Commission ("FCC" or "Commission") on the emissions limits required to protect the aeronautical radionavigation service ("ARNS") in the 4.2-4.4 GHz band from emissions from high density fixed and mobile operations in the 3.7-4.2 GHz band operating pursuant to proposed "flexible use" rules that would allow more intensive use of the band.[1] Radio altimeters, which provide information about an aircraft's height above

[1] FCC, Order and Notice of Proposed Rulemaking, *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, FCC 18-91 (released Jul. 13, 2018) ("*FCC NPRM*") at ¶ 125 ("[T]he adjacent 4.2–4.4 GHz band is allocated to the aeronautical radionavigation service on a primary basis and . . . at WRC–15, the 4.2–4.4 GHz band was also allocated to the aeronautical mobile (R) service on a

ground, operate in the 4.2-4.4 GHz ARNS band and serve as an essential source of information to pilots and critical aircraft safety systems.

## I. INTRODUCTION AND OVERVIEW

Founded nearly 30 years ago, Garmin, along with its affiliates, is a worldwide provider of navigation equipment, committed to making superior products for automotive, aviation, marine, outdoor, fitness, and sports uses that are an essential part of its customers' lives. Garmin has a long history of innovation and working with the Commission, other agencies, and communications and navigation stakeholders on vital issues concerning spectrum use.

Garmin is now a leading provider of certified aviation devices, including radio altimeters and other devices which are enabled by radio altimeters. Garmin's broad, overall product portfolio serves a wide range of customers and brings critical safety-of-life applications to the global marketplace.

Garmin has long supported the development of new broadband services in this country; it believes, however, that expanded broadband deployment should not result in potentially life-threatening interference with the operations of radio altimeters in the 4.2-4.4 GHz band.[2] In these Comments, Garmin discusses the vital role of radio altimeters in ensuring aviation safety

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primary basis in all ITU Regions with use reserved for WAIC systems. WAIC systems are onboard short range wireless systems that will replace substantial portions of aircraft wiring. These systems increase aircraft safety by providing dissimilar redundancy in communications links between aircraft systems. The Commission solicits comment on the needed out-of-band emissions limits required to protect the aeronautical radionavigation service in the 4.2–4.4 GHz band." (footnotes omitted)).

[2] "Use of the band 4200–4400 MHz by the aeronautical radionavigation service is reserved exclusively for radio altimeters installed on board aircraft and for the associated transponders on the ground." 47 CFR § 2.106, note 5.438, "The use of the band 4200–4400 MHz by the aeronautical radionavigation service is reserved exclusively for airborne radio altimeters." *Id.*, note US261.

and protecting passengers and crew on-board aircraft as well as the public on the ground, and the need to protect their operations in the ARNS 4.2-4.4 GHz band.

As noted by previous commenting parties, radio altimeters may fully utilize the 200 MHz of spectrum in determining the height above ground,[3] so determination of the needed emissions limits is critical to ensuring the safety of the public on the ground as well as inside aircraft. The aviation industry is currently conducting testing ("industry testing") of the potential impact on ARNS of proposals for "flexible use" of the 3.7-4.2 GHz band.[4] The results of such testing will provide highly relevant information about the emissions limits required in the 3.7-4.2 GHz band to protect the ARNS and its critical public safety contributions.

Premature action by the Commission could put public safety and human life at risk. The Commission should therefore defer adoption of any rules permitting flexible, high density use of the 3.7-4.2 GHz band and the establishment of definitive emissions limits until the industry testing is completed and the Commission has the opportunity to evaluate those test results in the context of this proceeding. To the extent that the initial industry testing may be constrained by lack of technical details regarding proposed more intensive use of the 3.7-4.2 GHz band,[5] the Commission should provide additional details about the specific operating parameters it is

[3] *See*, *e.g.*, Letter from Kris E. Hutchison, President of ASRI, to Marlene H. Dortch, gen. Docket No. 18-122 (filed May 31, 2018) ("*ASRI Ex Parte*") at 2; *Reply Comments of Aviation Spectrum Resources Inc*., GN Docket No. 17-183 (filed Oct. 3, 2017) at 3; *Comments of The Boeing Company*, GN Docket No. 17-183 (filed Oct. 2, 2017) at 3 ("Radio altimeters require access to the entire 4.2-4.4 GHz band because the accuracy of the resulting altitude data is directly related to the total bandwidth of the radio altimeter signal."). *See also* Recommendation ITU-R M.2059-0, *Operational and technical characteristics and protection criteria of radio altimeters utilizing the band 4 200-4 400 MHz*, February 2014 ("*ITU-R M.2059-0*") at 1 ("radio altimeters require a bandwidth of 196 MHz.").

[4] *See ASRI Ex Parte* at 3.

[5] Initial test results are expected to be available later this year or early next year, but further testing may be required to provide additional data necessary for a complete analysis.

considering for terrestrial transmitters that may be deployed pursuant to flexible use rules. Such parameters are necessary to determine the aggregate interference that a radio altimeter may receive. Garmin also urges the Commission to seek the advice of the Federal Aviation Administration ("FAA"), the expert agency charged with ensuring aviation safety, and fully coordinate with the FAA any proposed rules that could permit interference to the 4.2-4.4 GHz ARNS band.[6]

## II. RADIO ALTIMETERS PROVIDE ACCURATE HEIGHT ABOVE GROUND INFORMATION ESSENTIAL TO CRITICAL MANDATED AND VOLUNTARY AIRCRAFT SAFETY SYSTEMS.

The primary function of a radio altimeter is to accurately measure the height above ground of the aircraft.[7] Radio altimeters determine height above ground by transmitting signals toward the ground, directly or indirectly measuring the round-trip time for the reflected signals to arrive at the aircraft receiver, and calculating the height from the elapsed time.[8]

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[6] Such coordination was previously recommended by Delta Airlines, Inc. Letter from Kevin M. Heffernan to Ms. Marlene Dortch, GN Docket No. 17-183 (dated May 30, 2018) at 2 (also noting that prior to WRC-15 ITU study group participants rejected introduction of mobile services in bands adjacent to the 4.2-4.4 GHz band because of the inability to adequately predict their interference characteristics); by the International Air Transport Association, Letter from Douglas E. Lavin to Ms. Marlene Dortch, GN Docket No. 18-122 (dated 31 May 018) at 3; and by Aviation Spectrum Resources Inc. ("ASRI") in its *ASRI Ex Parte* at 3 ("Given the potential threat to aviation safety of life, ASRI strongly recommends that the Commission engage the FAA to inform and assess fully the potential for radio altimeter interference before allowing commercial wireless operations in the 3.7 to 4.2 GHz band.").

[7] *ITU-R M.2059-0* uses the terms "height above Earth surface," "height above ground," and "height above terrain" interchangeably. *See ITU-R M.2059-0* at 2. This recommendation also describes the services provided by and the operation of radio altimeters, noting that they are "an essential component of aeronautical safety-of-life systems, including precision approach, landing, ground proximity and collision avoidance systems." *Id.* at 1.

[8] *See id*. at 3, 5. While aircraft are also required to be equipped with barometric altimeters, these do not duplicate, and cannot substitute for, the functionality of radio altimeters. Barometric altimeters measure atmospheric pressure and use that data to compute altitude based on assumptions of standard sea level pressure, standard temperature and a defined lapse rate.

The height above ground parameter determined by a radio altimeter is, and has been for many decades, an essential input to multiple critical aircraft safety systems. These include the ground proximity warning system ("GPWS"), a safety-of-life system that was mandated in 1974, and that assists a flight crew by alerting the crew of conditions where an aircraft is operating in a manner that could lead to a controlled flight into terrain ("CFIT") accident.[9] GPWS requires a radio altimeter input to ensure correct alerting.[10]

Accurate determination of height above ground is also a critical parameter for the terrain awareness and warning system ("TAWS") that has succeeded GPWS. TAWS is a safety-of-life system "intended to provide flight crews with aural and visual alerts aimed at reducing the risk of CFIT accidents through increased terrain awareness."[11] Class A TAWS adds forward-looking

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Barometric altimeters, however, are subject to error sources that do not affect radio altimeters, including differences from standard pressure and temperature, errors attributable to the aircraft installation of the pressure sensor, and others. Finally, barometric altimeters inherently provide altitude information referenced to sea level, while radio altimeters provide altitude information referenced to actual ground level below the aircraft.

[9] FAA, Advisory Circular ("AC") 23-18 *Installation of Terrain Awareness and Warning System (TAWS) Approved for Part 23 Airplanes*, June 14, 2000 ("*AC 23-18*"), at 9.

[10] *See* RTCA, Inc., DO-161A, *Minimum Performance Standards for Airborne Ground Proximity Warning Equipment*, May 27, 1976 at vii & Appendix A Note. GPWS equipment "must meet the minimum performance standards set forth in … DO-161A …" FAA, TSO-C92c, *Airborne Ground Proximity Warning Equipment*, March 19, 1996 at 1.

[11] FAA, TSO-C151d, *Terrain Awareness and Warning Systems* (TAWS), August 31, 2017 ("*TSO-C-151d*") at 1. (TSO-C151d is the current version.) In 2000, FAA mandated installation of TSO-C151-compliant TAWS to further reduce CFIT accidents. *AC 23-18* at 10. Class A TAWS was mandated for installation in turbine-powered airplanes capable of carrying ten or more passengers. 14 CFR § 121.135 requires Class A TAWS for all turbine-powered airplanes, regardless of seating capacity. 14 CFR § 135.154 requires Class A TAWS for all turbine-powered airplanes configured with 10 or more passenger seats. 14 CFR § 91.1045 requires Class A TAWS for all turbine-powered airplanes configured with 10 or more passenger seats. Class B TAWS is required for other turbine-powered airplanes. Many operators not covered by the mandate have also voluntarily equipped their airplanes with Class A TAWS due to its safety benefit.

terrain alerting based on information included in a terrain database to the alerts provided by GPWS.[12] Like GPWS, Class A TAWS requires a radio altimeter input to ensure correct alerting.[13]

Accurate radio altimeter information is also essential to the traffic collision avoidance system ("TCAS II"), a safety-of-life system that "provide[s] collision avoidance protection for a broad spectrum of aircraft types."[14] The radio altimeter input of the aircraft's height above ground inhibits TCAS II from providing a traffic avoidance resolution advisory that could increase the possibility of a collision avoidance maneuver by the crew that could result in an aircraft's crashing into the ground.[15]

More recently, radio altimeters have been mandated as safety-of-life equipment for helicopter operations. In 2014, as a result of historic levels of helicopter air ambulance

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[12] RTCA, Inc., DO-367, *Minimum Operational Performance Standard (MOPS) for Terrain Awareness and Warning Systems (TAWS) Airborne Equipment*, May 31, 2017 at 4, specifying "Key Attributes by Class." TAWS equipment "must meet the requirements in RTCA/DO-367 …" *TSO-C151d* at 1.

[13] *Id*. at 73 ("Class A Equipment shall … contain or support an interface to a radio altitude source(s) that meet one of the TSOs for a radio altimeter source.").

[14] FAA, *Introduction to TCAS II Version 7.1*, February 28, 2011 at 5 ("*TCAS II Intro*"), https://www.faa.gov/documentLibrary/media/Advisory_Circular/TCAS%20II%20V7.1%20Intro%20booklet.pdf. *See* RTCA, Inc., DO-185B, *Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II)*, Version 7.1, Volume I, June 19, 2008 at 86. TCAS II equipment "must meet the … requirements in … DO-185B …" FAA, TSO-C119e, *Traffic Alert and Collision Avoidance System (TCAS) Airborne Equipment, TCAS II with Hybrid Surveillance*, June 30, 2016 at 1.

[15] FAA, AC 20-151C, *Airworthiness Approval of Traffic Alert and Collision Avoidance Systems (TCAS II), Versions 7.0 & 7.1 and Associated Mode S Transponders*, July 21, 2017 at 2-18 & 2-19. In 1989, as a result of a mid-air collision between a commercial passenger airplane and a privately-operated airplane, and a related Congressional mandate, *TCAS II Intro* at 8, the FAA mandated installation of TCAS II conforming to TSO-C119 in large airplanes. 14 CFR § 121.356(a); TSO-C119e. (TSO-C119e is the current version.) Many operators not covered by the mandate have also voluntarily equipped their airplanes with TCAS II due to its safety benefit.

accidents, an increase in other commercial helicopter accidents, and related National Transportation Safety Board recommendations,[16] the FAA mandated installation of radio altimeters in any helicopter operated under a part 135 certificate.[17] The displayed radio altimeter height above ground improves situational awareness during helicopter hover and landing.[18]

Finally, while not mandated by FAA regulations, radio altimeter height above ground is displayed to the pilot and used as an input to automatic flight control system ("AFCS") computers during airplane approach and landing operations.[19] Radio altimeter height above ground information is transmitted to pilot displays to improve the pilot's situational awareness during airplane approach and landing. The radio altimeter display improves safety by enhancing pilot awareness of the airplane's proximity to the ground as it descends to the approach's designated decision height where the pilot must determine whether to land or to abort the approach.[20] The radio altimeter input to AFCS also improves safety by supporting automation to

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[16] See FAA, *Helicopter Air Ambulance, Commercial Helicopter, and Part 91 Helicopter Operations*, 79 Fed. Reg. 35 at 9935-36. ("FAA Helicopter Rules").

[17] 14 CFR § 135.160.

[18] "Radio altimeters can greatly improve a pilot's awareness of height above the ground during hover, landing in unimproved landing zones, and landings in confined areas where a more vertical approach may be required. Additionally, radio altimeters help increase situational awareness during inadvertent flight into instrument meteorological conditions (IIMC), night operations, and flat-light, whiteout, and brownout conditions." *FAA Helicopter Rules* at 9933, Table 1.

[19] *See ITU-R M.2059-0* at 5-7.

[20] A radio altimeter display capability is recommended to be available for Category I approaches. FAA, AC 120-29A, *Criteria for Approval of Category I and Category II Weather Minima for Approach*, August 12, 2002 at 58. A radio altimeter display is required for each pilot for Category II approaches. *Id*. at 60. A Category I approach is an "instrument approach or approach and landing with a decision altitude (height) … not lower than 60m (200 ft) …" , and a Category II approach is an "instrument approach or approach and landing with a decision height lower than 60m (200 ft) but not lower than 30m (100 ft) …" *Id*. at Appendix 1, pg. 2.

ensure the airplane or helicopter is flown in a stabilized manner with controlled descent rate and speed.[21] Harmful interference to the radio altimeter during the final approach and landing could lead to loss of or misleading altitude information resulting in significantly increased flight crew workload and placing the aircraft, crew, and passengers at risk.[22]

The Commission must therefore ensure that any rules it adopts for flexible and more intensive use of the 3.7-4.2 GHz band do not allow such use to pose any risk of impairment of the functionality of radio altimeters or the accuracy of the information they provide to critical aircraft safety systems.

## III. THE COMMISSION MUST DEVELOP APPROPRIATE EMISSIONS LIMITS TO PROTECT RADIO ALTIMETERS FROM HARMFUL INTERFERENCE.

To calculate height above ground accurately, radio altimeters may fully utilize the available 200 MHz bandwidth in the 4.2-4.4 GHz band.[23] Further, most radio altimeters operate at relatively low power.[24] Thus, signals from ground-based transmitters in the 3.7-4.2 GHz band pose an interference risk that could lead to effects such as loss of altitude accuracy or false altitude measurements.[25]

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[21] *ITU-R M.2059-0* at 6. *See* also *id*. at 3 (noting "Radio altimeters are essential for landing on autopilot and in low-visibility conditions. Additionally, radio altimeters are employed when landing manually to help alert a pilot when to or automatically engage in a manoeuvre known as a 'flare', which is performed just before touchdown to lessen the force upon landing with the ground.").

[22] *Id*. at 6-7.

[23] *Id*. at 11 (noting that "radio altimeters operate in wide bandwidths to achieve the necessary accuracy levels … Reducing the available frequency bandwidth proportionately reduces the accuracy of radio altimeters."). *See id*. at 12-17, Tables 1 and 2 (listing chirp bandwidths for several radio altimeters).

[24] *See id*. at 12-17, Tables 1 and 2 (listing transmit power levels for several radio altimeters).

[25] *See id*. at 18-22 (explaining how interfering signals from other transmitters can cause receiver overload, desensitization, and false altitude generation resulting in loss of altitude accuracy or

The International Civil Aviation Organization ("ICAO") Frequency Spectrum Management Panel ("FSMP") has initiated industry testing of various radio altimeters ("RAs") under the auspices of the Aerospace Vehicle Systems Institute ("AVSI"). The industry testing is based on the performance, characteristics, and spectral vulnerabilities of a significant sample size of available industry radio altimeters. A September 2018 ICAO FSMP Information Paper summarizes the status of the testing and indicates the "testing [is] aimed at characterizing the behaviour of RAs under representative out of band (OOB) interference [i.e., interference from other services]. As this [industry] testing is on-going, only preliminary results are available to share with the meeting and general conclusions on RA susceptibility will be available only after completion of all planned tests."[26] Garmin is in discussions with AVSI to join this testing so that Garmin's radio altimeter designs can be included in the results.

However, the *FCC NPRM* is lacking important details about potential deployment scenarios, such as the permitted spacing of ground-based transmitters, as well as specifications for certain antenna parameters – such as height, gain/radiation pattern, downtilt, and polarization. These details are necessary to ensure that the AVSI testing can adequately characterize the potentially interfering signals from ground-based transmitters operating in the 3.7-4.2 GHz band,

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false altitude measurements). The on-going aviation industry testing is considering, among other things, the power levels of ground-based transmitters that may pose such risks. While the AVSI testing will identify the received power that will result in harmful interference effects in the set of radio altimeters tested, additional analysis (utilizing the contemplated network deployment details) is needed to turn the AVSI results into a power limit for ground-based transmitters in the 3.7-4.2 GHz band.

[26] ICAO, FSMP-WG/7 IP/16, *Susceptibility to Radio Altimeters to Out of Band Emissions*, September 12, 2018 at 1. https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG7/IP/FSMP-WG07-IP16_RA%20OOB.doc.

including aggregate interference.[27] Unless AVSI can incorporate this information in the test protocol, the AVSI testing will not be able to define the "emission limit required to protect the aeronautical radionavigation service in the 4.2–4.4 GHz band."[28]

Additionally, Garmin is concerned that harmful interference may affect a radio altimeter even when it is a substantial distance from a single ground station in the 3.7-4.2 GHz band. Radio altimeters utilize band pass filters to protect against overload interference from adjacent services.[29] However, when the interfering signal exceeds the limits of the bandpass filters, overload interference will occur. "[A] radio altimeter is susceptible to interference both within its operational swept bandwidth as well as from outside this bandwidth."[30]

Garmin's preliminary technical analysis of the proposed transmissions[31] suggests that radio altimeters could experience harmful interference at distances in excess of several kilometers from a single ground station antenna. Garmin's preliminary analysis suggests that the proposed 1640 W EIRP limit for the 3.7-4.2 GHz band does not adequately protect the full 200 MHz of spectrum in the 4.2-4.4 GHz ARNS band from interference. As noted above regarding the AVSI testing, in order to conduct a more thorough analysis, additional information is needed to determine the aggregate interference that may be received by a radio altimeter. Garmin

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[27] *See ITU-R M.2059-0* at 22 (noting "it is important that all the possible interference sources are aggregated appropriately.").

[28] *See FCC NPRM* at ¶ 126.

[29] *ITU-R M.2059-0* at 19, Table 3 (specifying RF filter attenuation).

[30] *Id.* at 18.

[31] *See FCC NPRM* at ¶ 164 (proposing a fixed and base station transmission power limit of 1640 watts EIRP for emission bandwidths less than one MHz in the 3700-4200 MHz band). The preliminary analysis coupled this power limit with assumptions and radio altimeter technical characteristics from *ITU-R Rec M.2059-0*, and a generic 5G antenna model.

therefore strongly requests that the Commission provide the needed additional information in order to preserve public safety.

## IV. CONCLUSION

The radio altimeter has proven its value in reducing aviation CFIT accidents as an essential input to critical aircraft safety systems including GPWS, TAWS, TCAS II, AFCS, and pilot displays.[32] The Commission must ensure that any new flexible use rules providing for more intensive use of the 3.7-4.2 GHz band prevent harmful interference to, and permit continued use of, radio altimeters, which have a 40+ year track record of improvements to aviation safety and reduction in CFIT accidents. Garmin has long supported development of new broadband services in this country; however, broadband deployment in the 3.7-4.2 GHz band must not come at the cost of loss of the critical safety benefits of ARNS operations in the adjacent 4.2–4.4 GHz band.

The Commission should therefore delay adoption of any changes to its rules for the 3.7-4.2 GHz band until the completion of the on-going AVSI testing program. Moreover, to ensure that testing produces complete and accurate information, the Commission should provide additional details about the ground-based transmitters the Commission proposes to allow to

[32] Attesting to the value of radio altimeters, in 2012 then Acting FAA Administrator Michael Huerta wrote, "It is important to note that the mandatory installation of TAWS into U.S. commercial aircraft is considered by many to have made the single greatest impact to improving U.S. commercial aviation safety in the last 20 years." Letter of Michael P. Huerta, Acting FAA Administrator, to The Honorable Lawrence E. Strickling, Administrator, National Telecommunications and Information Administration, Jan. 27, 2012, available at https://www.ntia.doc.gov/files/ntia/publications/faa_administrator_letter_to_ntia_administrator_27_jan_2012_faa_report.pdf. *See also* Federal Aviation Administration, *Factsheet – Out Front on Airline Safety; Two Decades of Continuous Evolution* (Aug. 2, 2018) ("Terrain Awareness and Warning Systems (TAWS) alert pilots when they're flying too close to terrain. It's one of the technologies that has virtually eliminated the risk of controlled-flight-into-terrain accidents in U.S. commercial passenger operations.").

operate in the 3.7-4.2 GHz band. Without this information, the AVSI test results will not be able to support definition of the specific emissions limits for equipment transmitting in the 3.7-4.2 GHz band. Finally, Garmin recommends that adoption of any rules that could adversely affect aviation safety be preceded by explicit FAA determination and confirmation that the proposed flexible-use ground-based operations in the 3.7-4.2 GHz band are compatible with ARNS in the 4.2-4.4 GHz band.

Respectfully submitted,

**GARMIN INTERNATIONAL, INC.**

By: ___/s/__Helen E. Disenhaus__

Helen E. Disenhaus
Telecommunications Law Professionals PLLC
1025 Connecticut Avenue, NW - Suite 1011
Washington, DC 20036
Phone: 202-789-3123
Fax: 202-789-3122
hdisenhaus@telecomlawpros.com
Its Attorneys

Clayton Barber
Principal Engineer
.
Garmin International, Inc.
1200 E. 151st Street
Olathe, Kansas 66062
(913) 440-1375 Direct
913-596-8495 Mobile
clay.barber@garmin.com

David Kight
Asst. General Counsel
Employment and Regulatory Affairs
Garmin International, Inc.
1200 E. 151st Street
Olathe, Kansas 66062
(913) 440-6151 Direct
(913) 397-9079 Fax
david.kight@garmin.com

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